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ABSTRACT

This paper presents the second study in a series that has been designed to manifest the emergence of consciousness and to measure developed competence. Its major aim has been to demonstrate that an invariant formulation of the Agent-action-Objective model and an analysis of it's a-O kinematics have the capacity to reproduce contour similarity over time. Within the studied evolutionary-developmental context, the biokinetics of the discovered AaO-mechanism has governed the synthesizing of information. Through the design of a single-subject experiment, it has been possible to demonstrate individual variations in growth as changes in complexity. When the two participating students are compared, obvious differences in their perspectives and consequently in their attractor spaces become apparent. Based on coordinated structural invariance, it has been possible to show that the convoluted spaces of the student who has followed the analytic-descriptive approach is concerned with the concrete level of the tested story. On the other hand, the student who is following a synthetic-reflective strategy seems to concentrate mainly on the symbolic level of the tested materials. Thus, from a developmental point of view, it has been possible to demonstrate that the AaO-mechanism is tracing embodied growth, which becomes manifest in the differences of the students' ability to adapt to the main idea of the given story. (Contains 8 figures and 14 references.) (Author/SLD)

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Abstract

This article presents the second study in a series that has been designed to manifest the emergence of consciousness and to measure developed competence. Its major aim has been to demonstrate that an invariant formulation of the Agent-action-Objective model and an analysis of its A-O kinematics have the capacity to re-produce contour similarity over time. Within the studied evolutionary-developmental context, the bio-kinematics of the discovered AaO-mechanism has governed the synthesising of information. Through the design of a single-subject experiment, it has been possible to demonstrate individual variations in growth as changes in complexity. When the two participating students are compared, obvious differences in their perspectivation, and consequently in their attractor spaces, become apparent. Based on coordinated structural invariants, it has been possible to show that the convoluted spaces of the student, who has followed the analytic-descriptive approach, is concerned with the concrete level of the tested story. On the other hand, the student, who is following a synthetic-reflective strategy, seems to concentrate mainly on the symbolic level of the tested materials. Thus, from the developmental point of view, it has been possible to demonstrate that the AaO-mechanism is tracing embodied growth, which becomes manifest in the differences of the students' ability to adapt to the main idea of the given story.

Within the evolutionary-developmental context, approaching growth in competence means transforming its structure from a simple to a higher or more advanced form. But generations of researchers have neglected competence and considered it as a scientifically void concept. In contrast, most representatives of the private as well as the public sectors consider the concept as important (I. Bierschenk, 2000; B. Bierschenk, 1995). Despite its decisive influence, its complexity and dependency on language have ruled out any possibility to capture its essence through extensive writing of rules and calculation.

Nevertheless, in concentrating on content analysis and the construction of classification systems, various text analysis systems have been developed for picking up its components, especially those involved in cognition (McClelland, 1973). But with little success in the effort to extract its essence and to unravel the structure behind the concept, these efforts have ended in frustration. And consequently, the concept has been deemed to be of no import for scientific inquiry in general and psychology in particular. This may be the reason why it is no entry of significance in the lists of termini in psychology (Drever, 1967; Reber, 1977; Walker, 1994). By triggering structural change, the extent to which a learning environment can induce particular strategies of competence development can be profound. However, only certain individuals may be the evolutionary aim point of unusual forms of growth in competence. Alternatively, only specific parts of its structural configuration might be affected by a growth spurt. Consequently, in the hope of getting at the core of the concept, its textual manifestations have been approached head-on.

The present study is the second one in a series, which is directed towards the "growth" of the strands of the concept. The production of text building behaviour, the entanglement of individual components as well as the dynamics in the kinetics of text building is expected to contribute to the manifestation of the phenomenon of competence, its structure, its rings and their richness. Further, it is expected that the present study can contribute with the appearance of a deep commonalty, ingrained in the resulting "holophors". The terminus "holophor" will be used with the purpose to make evident that structure requires the concepts of wholeness and evolution. Thus, balancing non-linear displacement operations in the expression of competence implies the coupling of the structure, underlying a produced text (representing wholeness), with the dynamical states of one's competence expression.

Common to the description and study of the behaviour of complex dynamical systems is the observation that conservative self-organising processes appear in the neighbourhood of thermodynamic equilibrium states. At a distance from the equilibrium are the phase transitions dependent on non-linear mechanisms. Equilibration of the non-linear operating processes guarantees order. In general, non-linear systems are those, which are open and their dynamics can be described as future states, which are non-linearly dependent on state change and the presence of control parameters.

In the context of the Agent-action-Objective (AaO) paradigm and evolutionary language dynamics, Perspective Text Analysis (PTA) (Bierschenk & Bierschenk, 1986), through its latest developments offers a route to the study of abstract and high-dimensional spaces (B. Bierschenk, 2001; I. Bierschenk, 2003). PTA is now equipped with a procedure for real time imaging of the dynamics in the rotations governing a verbal flow (B. Bierschenk, 2002). But equally important has been the shift in the basic experimental layout of the study of verbal flows. Instead of comparing groups of people the experimental procedures concentrate on the single individual. Thus the text production of a single subject will be studied with the attempt to unravel the characteristics of analytic and synthetic thinking. These have been shown to be higher-order constraints, which are related to one's degree of consciousness and how it affects the development of competence (Bierschenk & Bierschenk, 2003).

Competence as Dynamical Concept

PTA has the capacity to control simultaneously attunement and the so-called executive function needed for writing-reading-rewriting performances. To understand how the individual text producer is integrating gained competence into text is expected to shed light on how his mind is shaped. Focusing on the shape of mind, however, does not mean that one can expect to find simple and independently working functions. Rather, it may be expected that there is a multiple and subtle functioning dependency at work. The assumption is therefore, that accumulated efficiencies or deficiencies are forming the shape of mind. Hence, the dynamics in thinking and the particular functional integration of its rotational magnitude is expected to contribute to the establishment of holophors as the individual expression of the dynamics in a certain style of writing.

The key for unlocking competence must therefore be searched for in the single person. The present study is expected to contribute to the reformulation of competence into a dynamic concept. It follows that some of the features, which are contributing to the shaping of a textual expression must relate to the subtle phenomenon of tracking the "red thread" or "virtual string" of a particular text production. Thus, what makes the investigation into the dynamic properties of the concept of competence differing from classical (static) approaches is that the study allows for real time imaging of its dynamical states and the introduction of the concept of space (B. Bierschenk, 2002) into the study of language.

But applying the space-concept (Wheeler, 1999; Greene, 1999) to the study of competence requires a successful manifestation of the validity of the hypothesis of virtual strings and in particular their resonating properties in the form of strings of graphemes. Furthermore, to catch the fundamental implications of this hypothesis in the context of evolutionary language dynamics, corresponding string movements have to be observed at the textual level. In an attempt to establish morphogenetic development as well as structural stability within a language space, the functional geometry, proposed by Hestenes (1993) has been used for the construction of an efficient geometric basis for the observation of string movements and the description of their pattern dynamics.

This dynamical approach is independent of designing teaching methods that are expected to increase the individual student's ability to develop competence. On the contrary, unlike the usually transient forms of the teacher's linear planning and content analysis, this dynamical approach is building on the establishment of non-linear processing and on the dynamics of state attractors. If stable, those attractors appear to be invariant over time. Further, they are expected to exert subtle effects that are difficult to discern with conventional methods, i.e., with traditional statistical techniques and sampling. Since it has been possible to discern some critical factors of influence, PTA has been shown to resolve a major obstacle for observing these states. Screening the entire trajectory in a state space allows for the location of linkages. But the possibility of identifying both week and stronger ones implies a major step in the identification of certain degrees of consciousness and consequently corresponding differences in developed competence.

The search for some higher-order constraints has been initiated only recently. Thus far, two studies have been planned and carried out. One has been directed towards the establishment of the "fitness landscapes" of two students, who differ with respect to their analytic-descriptive and their synthetic-reflective capacity. This study has been reported in Bierschenk and Bierschenk (2003). The other study will be reported below, while the planning of a third study has been initiated during the academic year (2002/2003).

Through the application of PTA, it has been possible to show that the method is picking up crucial structural information from text. The discovered forms of competence have made evident that individual variations in a particular state space are generating

corresponding structural invariants. Further, the dynamics of competence, as it appears through the use of language, can be captured only through the emergence of an AaO-system. Its most simple form appears in evolutionary changes, which become manifested as information carrying AaO-rings. It follows that an emerging structure must build on the pre-condition that a particular style of writing becomes evident in the moment when text gets its manifestation in the ring structure of a string of graphemes.

The String Hypothesis in the Context of Language Dynamics

The fundamental property of the string-hypothesis is that it replaces the hypothesis of a zero-dimensional point. In analogy with the one-dimensional string, proposed by string physicists, the string-hypothesis, as presented by Greene (1999, p. 14), is founded on the premise:

> ... that a particle is not pointlike, but instead consists of a tiny one-dimensional loop. Like an infinitely thin rubber band, each particle contains a vibrating, oscillating, dancing filament /.../ named a *string*.

This property appears to be perfectly suited for the description of the grapheme-string. The strings (σ) in the creation of a language space become realised in the moment, when a verbal flow is produced. But expressing something through natural language implies the appearance of a virtual string (v). A phase transition from virtual strings to textual strings transforms the flow into a flow of graphemes (g). Thus, at the kinetic level of text production, verbal flows are generating flow-fields of the functional clause (FC), in which produced strings can vibrate and fluctuate and become persistent in the form of the directional bi-vector ($g=v\wedge\sigma$), which means that the expression becomes materialised in the form of a spinor. The significance of (FC) is founded on the hypothesis that distance is a function of rotational acceleration and that "spinors" of (FC) have the capacity to carry a text segment of varying complexity.

Hestenes (1993, pp. 66-68) asserts that the angle ($|\theta|$) represents the magnitude of a spinor. This circumstance can be used thermodynamically in the determination of the degree to which vector (σ) can wrap vector (v) through winding. Hence the directed area between the vectors represents the magnitude of winding in the spinor ($|g|$). It follows that winding is determining the minimum state of the rotation of a two-dimensional sheet of texture. Since any phase transition from a virtual to a material state results in a decrease in symmetry and spinor mathematics offers a notation that can control broken symmetries of (FC), it has the capacity to establish a prismatic textual surface and to represent graphemes as directed surface segments.

What kind of strings are emerging, however, depends on the dynamics in the verbal flow carrying the graphemes. Furthermore, to get at the angular articulation and rotation of strings of graphemes, corresponding movements have to be observed at the textual level. Therefore, the first level of processing concerns the textual surface, while the "messengers" of (FC) are directing the second level. Messengers are governing the entanglement of states and exist as local properties, e.g. small patterns. In (FC) they are corresponding to the verb and the conditions before and after the verb.

Since the textual surface constitutes the input level, every textual element is marked with its curling value and a position (ϕ) or (θ). Moreover, a position invariant property in the form of propagating dummies ($\varnothing_A$) and ($\varnothing_O$) is directing the verbal flows and consequently corresponds to the propagating cells of (FC). A dummy can appear anywhere in the textual surface and thereby trigger necessary supplementation routines. Finally, the introduction of the space-concept has made it possible to define the concepts of neighbourhood, speed and

acceleration operationally. These concepts are of particular import in the demonstration of the evolutionary property of language production. But only the spherical dependency of mono-layered and multi-layered variable composites can recognise the existence of a non-linear relationship and consequently the development of a language space. Thus, the topic to be treated in the present study concerns the coupling between the concept of competence and the textual A- and O-kinematics that must be controlled.

Linear Planning for Promoting Non-linear Processing

To reiterate, the introduction of the space-concept has made it possible to define the concepts of distance operationally. Speed and acceleration are of particular import in the demonstration of the evolutionary property of language production. Moreover, the observations on the gradient dynamics and the evaluation of angular articulation as an expression of "attitude" change become possible. In the simplest case, dynamical properties can be derived from the gradient of local textual pattern movements. Movement patterns (Gestalts) can be evaluated on the basis of local oscillations, which however appear as global.

It follows that a complete invariant formulation of the involved kinematic computations contributes to the unfolding of the individual's style of writing, and hence, its perfect control. Therefore, it can be stated that the kinematic control of the evolutionary-developmental properties of competence is an essential prerequisite to the understanding of how the writing style of a particular person operates in the linear planning of a discourse. Described in terms of a perfect 3D writing style control, a kinematic analysis of competence is the essential link between linear planning and non-linear processing of the information carried by the string-grapheme compounds.

The transition from general dynamical systems to evolutionary-developmental language processing requires the concept of adaptation, which may be conceived of as local "optimising" of a verbal expression. Here optimising means the production of properly fitted strings of graphemes. Further, the integration and fusion of textual movement patterns into composites means that textual elements always become defined locally. Since the transition from proper production of elements to the evolution of an entire text must proceed over the sequencing space of the strings, the following questions may be raised: Can a teaching program attune young students to effectively read and process text materials, such as literary essays? Or is this capacity a matter of development, which cannot be effected by teaching?

Against the ongoing discussion of the literacy of young people, this is a justifiable concern. That it is possible to generate a developmental function in school has been the working assumption of the previous experiment on competence development (Bierschenk & Bierschenk, 2003). A strictly linear planning of the teaching process has been shown to lead to the identification of indicators, which discriminate between students of high analytical and synthetic ability, respectively. The demonstrated test results may therefore be taken as a cue to differences in their learning strategies. The two students, who have been sensible to analytic-descriptive and synthetic-reflective structures respectively, will also in the present study serve as experimental subjects.

The time interval between test occasions is of import in traditional longitudinal studies. A tight control of elapsed time is assumed to have significance, provided the changing conditions are of the macro-type. However in a micro-perspective, indices concerning individual strategies of behaviour may be less efficient, since a certain behavioural outcome may generate serious measurement difficulties. Multiple factors of disorder may militate against the simplistic design of traditional behavioural experiments.

The usual strategy of constructing interconnectivity, i.e., associative connections, is doomed to fail whenever the behavioural system under investigation is non-linear. What makes the present study differ from classical cross-sectional as well as longitudinal approaches is that language, conceived of as a self-organising system allows for the study of multiple stable states. Since these state depend on changes in a system's own parameters, and not necessarily on external input, non-linear dynamical states can organise themselves in unique ways both in space and time. Thus, dynamical systems are responding to stretching, compressing, twisting and bending in natural language production. This condition is producing a difference between formed AaO-units and their con-textual environment. The cause-effect configuration of the AaO's as dynamic of non-equilibrium and equilibrium states, however, is maintained by their steady states (i.e. floating equilibrium states), the rest is environment.

As a consequence, in writing, self-organisation is possible only if a structured environment exists. The operational closure of the AaO-unit is producing the dissection of it from its environment and provides for the foundation of structure within a configuration of AaO's. But closure allows only for certain conditions, namely those, which reciprocally reproduce AaO's. Within a configuration, reciprocal self-production can appear in a manifold of forms. Which form of the equilibrium becomes realised is dependent on the form of the non-equilibrium at the borders of (FC). And this form becomes determined by the structure of the surrounding textual context. These structures produce the resources for the maintenance of a text in its entirety as well as the internal dynamics of its AaO-units.

Thus, the circular causality of the A's and O's mediates between environmental structure and system dynamics. It is therefore only natural to put less weight on the intervals of clock-time or linear time. Since the order of the AaO's is independent of the changes in the environment, attunement processes are expected to have greater fitness value. It follows that a particular AaO-unit can both adapt to a changing environment and maintain its identity. With respect to the experimental subjects this means that a teaching process cannot invalidate its capacity to adapt to novel conditions. In this respect, the adaptability of the AaO's to the requirements of the school is contrasting the Darwinian notion of adaptation. Quite concretely expressed: adaptation is not the achievement of the environment. Instead, it is an achievement of nature.

As a result of the first experiment, the text spaces of the two students are markedly different in their contours, but may be expected to near each other in the present study. Against this background, the hypothesis may be formulated that a particular student's attunement may have been hidden by the task of the first experiment. Since structural sensibility develops non-linear, it may be discoverable at later occasions.

Evidence of Synthesis

The major aim of the present experiment is to investigate whether and to what degree evolutionary growth can be established over time. From the methodological point of view, the question is whether the design variables of the preceding experiment can be influenced through the design of a teaching strategy. For example, in a macro-perspective, it could be expected that changes in the teaching strategy may influence synthesis and consequently text building behaviour. If so, these changes should be reflected in the text spaces and generate ostensive deviations from the contours of the first experiment. On the other hand, no marked difference in the contours implies that the two subjects have not changed their relative position. Similarity in the intra-individual comparison still requires an investigation into the sensibility of the strategies with respect to a new text material. Therefore, the following hypothesis can be formulated:

A person, who is characterised by the synthetic-reflective style of approach, is changing over time when he is exposed to a teaching program, while a person, who is characterised by the analytic-descriptive style and exposed to the same teaching program, shows no apparent changes.

Participants

The study was carried out during the academic year (2002/2003) and the 30 students from the previous experiment have participated again. At the time of the previous experiment, they were just enrolled in the social science program, which means that they now are in their second year of study. At present, they are between 17 and 18 years of age. The two students of the preceding study (Bierschenk & Bierschenk, 2003, pp. 6-9) continue to be in the focus of interest.

Materials

The selected test materials, has been the novel "Dvärgen" ("The Dwarf") by the Swedish author Pär Lagerkvist. The test was given at the end of a period with varying contents of the Swedish subject matter. The period covered, did range from the test occasion when the students were asked to respond to the Iceland saga of the preceding study. A more detailed description of the actual teaching period between these two test occasions will be given in the section on "Design and Procedure".

> "The Dwarf" was written during the Second World War and was published in 1944. The novel is concerned with the mechanisms of wickedness and is narrating them at the symbolic level. Concerning their expression in the world and through single individuals, the action level is designed within the context of the Renaissance period of Italy. The dwarf is the narrator of the novel and its main character. He is the clown of the princely court and has the task to make people laugh at his nastiness. The dwarf is haughty, ingratiating and scheming. He is disgusting everyone, who shows signs of feebleness and human feelings. Only in case he can sense a scent of war, blood and death is he becoming excited. By means of the diary he is writing, his sympathy for power is emerging, which is personified through the prince. His antipathy towards adolescence, naïve friendship and love, for example in the shape of the princess Angelica, is equally present in his diary. The dwarf is the figure, which is creating intrigues at the court and is machinating towards war. Finally, he is managing to bring about the big catastrophic event, namely through poisoning the lords of war during a celebration of reconciliation of the former enemies. However, in the end the prince is disclosing him. He falls into disfavour and is thereafter taken into custody by the prince himself. As he is sitting in his dungeon he is nevertheless in good fashion. He is bidding his time, because he is completely sure of his release in due time, since his lord cannot be without him.

The novel contains a great many allusions to events at those days in that persons and everyday occurrences are interwoven in the course of events. The prince may easily be recognised as Niccolò Machiavelli's ideal of a prince and the all round artist Bernardo, who is contributing to the war machinery of the prince, may be interpreted as Leonardo da Vinci.

The teaching process has been concentrated on the "inter-text" qualities such as Leonardo's painting of Mona-Lisa and Lucrezia Borgia's wedding. And when the dwarf becomes scourged, it is easy to draw parallels to Christ's history of passion. Angelica and Giovanni is a couple, whose history is identifiable with Romeo and Julia, which become the sacrificed, because of the hatred of two hostile families. The picture of the time is further

enhanced through the construction of a campanile and the outburst of plague in the city. Finally, the reading of Petrarca's poem's to Laura during rest in the battle makes its contribution to the historical background.

The historic novel in shape Lagerkvist's has many advantages: The problem taken up is made timeless. Some political and cultural patterns can be elevated and many parallel lines can be found to our age. As test material, it has been assumed that the text would be functional and fill its place, because the many appended courses of action contribute to the reader's possibility to focus on various thematic lines and contents. This is however dependent on the style of approach, which the single student has developed during the course. The main theme is the fight of evilness against goodness and love, which is moulded into several motifs, e.g., the powerful position of the wicked favourite, the politician, who believes that the end justifies the means, the scientist in the service to the power, the person and his shadow, as well as the triangle of love and the youthful lovers, who cannot be united.

Personification of the evil, created by "The Dwarf", constitutes a super ordinate symbolic level, however not equally obvious to each and every one of its readers. A student, who is structuring the test material by means of an analytic-descriptive approach, may at the level of interpretation perhaps be attracted to something concrete and comprehend war and the preparations for war as the main scenario. Probably, this circumstance should have as its effect that the student is easily establishing parallels to the Second World War (the time of the creation of the novel). Coming into sight is the wickedness of the Nazi-regime and the evilness of Nazism. The prince appears as a modern dictator, who is using scientists and artists for his war endeavours. On the other hand, a student, who is approaching the novel in a synthetic-reflective manner, should instead conceive the prince and his dwarf as a symbol of the stunted I-relation of humans. The causes of stunted-ness and their effects make up the basis for the creation and presentation through the diary-conversation of the dwarf. His complete inability to have good feelings toward others and to understand or carry out good actions is the author's way of making concrete the deficiencies of the prince as human being. The fundamental idea may be described through the following quotation:

> "But what humans become afraid of is their self-hood. They believe it's me, who frightens them, but it is the dwarf within themselves /.../, who is sticking out his head from the deep of their soul. They become afraid, because they don't know that they accommodate another being in their selves." (Authors' translation from Swedish)

In the interpretation at the symbolic level, the prince is conceived of as instrumental. He is a means for his own and others lust for power, but in an interpretation at the concrete level, he is conceived as a responsible person or agent.

Design and Procedure

In agreement with the previous study, the present one has also been designed as a single subject experiment. The procedure followed is strictly worked out and incorporates alternating analytic and synthetic based tasks. After about six months of elapsed time, the procedure was ended in March 2002 with a test on the Icelandic saga "Gunnlaug Ormstunga", which were embedded into a reading assignment concerning the literature of the Middle Ages.

The succeeding study program was directed towards more modern parts and the exams were both oral and written. During the month of April, the reading concerned novels about childhood. This kind of literary text is very often produced as self-biographies, which contain descriptions of milieu and society as part of the explanation of a person. The teaching of those aspects has been laid out in such a manner that every aspect got its own individual treatment during the time that preceded the testing of the Icelandic saga. The assignments were directed

towards the production of a written characterisation of a particular figure, a certain milieu and the narration of other cultures. The latter included the narration of societies.

As an introduction to this part of the study program, the students were asked to read some famous parts from known Swedish authors, like August Strindberg's "Tjänstekvinnans son" ("Son of the Maid"), written in 1886. Other novels were Pär Lagerkvist's "Onda sagor" ("Evil Tales") from 1924, and P. C. Jersild's "Barnens Ö" ("The Children's Isle"), which appeared in 1976. Together, these three novels cover not only different periods of time but are also different in their style and content of ideas. Comparisons were made with respect to the circumstance under which the children lived in former days and nowadays. The perspectives of the authors on the children's life were especially highlighted.

After this introductory period, the class was divided into two halves. One of them had to read Pär Lagerkvist's "Gäst hos verkligheten" ("Visitor to Real Life"), while the other half turned to Harry Martinson's novel "Nässlorna blomma" ("The Nettles are Flowering"). In relation to this reading the following task was handed out: Give a written account of your reading, such that the literary categories of analysis, which have been exercised so far, are coming into use and in an integrated manner. Observations of language and style have to be contained. The directions for writing were given on paper. Additional and complementary to this assignment was a second task: Discuss your readings within the context of a small group. The aim of this exercise was to give the students the opportunity to deepen their analyses and to express personal feelings and ideas, conceptions, notions or imaginations. Equally important was the exercise in listening to others.

The students participated during the month of May, and continued to the end of the Spring-period, in a project, which was carried out in co-operation between the subject teachers of Swedish and History. The task of concern for the Swedish teacher was an oral presentation of a topic from modern history. The choice of the topic was the student's. This part of layout of the strategy is connecting to exercises, which occupied a period during the Autumn-term and implied the task of carrying through a smaller presentation of a subject of personal choice. The exercise was especially concerned with the application of technical demonstration means. This period extended over the summer vacation and initiated the study weeks of the Autumn-term, where the other test occurred.

The new annual course was initiated with the study of the Renaissance period in the literary history. Precisely as during the study of the literature from Ancient times and the Middle Ages, the study was directed by means of assignments concerning the texts and their backgrounds. Study progress was controlled with home assignments as well as work to be carried out during the lessons. During this four-week period, the success of study was, like the reading of Ancient times, controlled with a paper-and-pencil test, which proves the reproduction of facts. However, this time, the test was completed in small groups. This arrangement was expected to give the students a feeling that they hade reached a higher level of performance, where fact-based examination has lesser weight. With the purpose to introduce a more advanced type of analysis, the students were asked to read Pär Lagerkvist's novel "The Dwarf".

This new pursuit did require two steps: (1) an individual and written answer to a question, which addressed the central idea of the novel, but without preparation in class and constrained by the time limit of a lesson. (2) Thorough analysis of the novel was required, according to a scheme, which introduced partly new categories of analysis, compared to the categories introduced during the preceding annual course. This kind of following up the work is meant to be the introduction to a new phase in the teaching process. The latter will be described in a coming article.

Thus, the period between the testing of the "Gunnlaug Ormstunga saga" and the testing of "The Dwarf" constitutes, from the planning point of view, a linearly designed

teaching process, which is aiming at the integration of various kinds of knowledge from previous parts of the course. But the design of the procedures should facilitate transformations and consequently non-linear processing. Having arrived at the second testing occasion, the teacher gave the following instruction orally:

> Now, you have studied the period of Renaissance and have deepened your studies by reading a novel. This book was written in 1944, but the action plan of it has been transferred to the times of Renaissance, for various reasons. Among other things, this work is called a problem-novel. What I would like to know from you now is: Which of the ideas is the most central one? Please explain what you mean. Write it brief.

Results

The results relate to a token. The token refers to a bio-kinematic mechanism, which is governing the development of a particular "writing style". Each token is producing its own unique physical context for the expression of evolving differences in development and degrees of growth. The Swedish text and its literal translation into English of the produced tokens (A2) and (B2) follow now:

Token (A2): Original Swedish Production

Jag tycker det är tydligt att idén är tagen från nazismen och det som hände i Europa kring 1940. Hitler använde vetenskapsmän för att hitta skillnader på raserna. Det använder Fursten i boken också Mäster Bernardo även om han inte letar skillnader. Fursten bygger upp en krigsmaskin full med nya vapen precis som Hitler. Venetianerna verkar vara judarna, ofantligt rika men vill ej låna ut pengar.

Token (A2): Literal Translation

I think it is clear that the idea is taken from Nazism and that which happened in Europe around 1940. Hitler used scientists to find differences in the races. The Prince in the book also uses this Master Bernardo even though he does not seek differences. The Prince builds up a war machine full of new weapons just like Hitler. The Venetians seem to be the Jews, immensely rich but do not want to lend money.

Token (B2): Original Swedish Production
(The many marks (#) are indicating the paragraphs in the handwritten text.)

Något som jag börjar tänka på är att våld föder våld, ondska föder ondska. Dvärgen är som en kopp där man sökt hälla ner för mycket bitterhet och cynism. Nu består han endast av hat. # Och för att hata så mycket måste han hata sig själv. # Hans mor stötte bort honom, folket hånar honom. # Han verkar försöka upprätthålla en självbild av ohygglig egoism och högmod/högfärdighet men det bryter igenom. Om han inte kan älska något utanför sig själv, kan han knappast ha något att älska inombords. # Allt som är vackert betraktar han som fult. Allt som andra njuter av plågar honom. Däremot, allting som orsakar lidande ger honom njutning. Kanske för att han ger tillbaka. Nu får de känna på den smärta jag fått utstå. Det som är konstigt är hur han kan plåga de som faktiskt visat honom en sorts tillgivenhet, Furstinnan med sina ord, dottern med sitt förtal om Giovanni. # Så på ett sätt känns idén som varför man hatar varför man borde bli pacifist. # Krig skapar bara mera krig, blodbad får bara mera blod

att rinna, och hämnd och hedersmord skapar bara en ond cirkel. # Tänk om de hade låtit det få vara fred mellan furstendömena? Då hade förmodligen ett flertal liv räddats, bland annat de unga älskandes, som en dag kanske hade gift sig och flätat samman rikena, och furstinnan.

Token (B2): Literal English Translation

Something that I begin to think of is that violence is breeding violence. The Dwarf is like a cup, which one has tried to fill up with too much bitterness and cynicism. Now he consists of hatred only. # And to hate that much he must you know actually hate himself. # His mother pushed him away, the people make fun of him. # He seems to try to maintain a self-image of dreadful egoism and arrogance/vanity but it breaks through. If he can not love anything outside himself, he can hardly have anything to love in him. # Everything which is beautiful he regards as ugly. Everything which others enjoy is tormenting him. On the contrary, everything that causes pain gives him pleasure. Maybe because he hits back. Now they will experience the pain I have sustained. That which is strange is how he can torture those who in fact have showed him a kind of trust, the Princess with her words, the daughter with her slander about Giovanni. # So in one way the idea feels to be why one hates and why one should become a pacifist. # War just creates more war, massacre just makes more blood flow, and revenge and murder of honour just creates a vicious circle. # Just think had they only let it be peace between the principalities? Then probably several lives had been saved, among others the young lovers', who one day maybe had married and twinned together the kingdoms, and the Princess.

The tokens will now be analysed with PTA in order to find out whether and to what degree (A2) and (B2) can be separated in the same way as was possible with (A1) and (B1) of the preceding study. Since the assumption in this context has been that a reflective strategy to a higher degree than an analytic one gives expression to the development, it may be expected that the potential of the locally defined pattern movements is influenced by the non-linear evolution of the phenomena.

In the previous study, it has been demonstrated that non-linearity is the result of the introduction of a certain kind of strings, i.e., virtual strings (v). In particular, these strings are producing alterations and new composites. It follows that the production of virtual strings is the essential element in the evolutionary growth process. But in order to describe the discrete property of new sequences of grapheme strings, this property must be made dependent on the developing sequencing spaces. It may therefore be expected that the operation of unfolding these spaces will make it possible to discover corresponding differences in the spaces of (A2) and (B2). Through the localisation of realised textual elements and the determination of their systemic functioning at certain and precisely definable places, it has been possible to show that "super-strings" in the form of variable (α, β) composites are established as prerequisite for the development of a concentration space.

To reiterate, a super-string constitutes the fundamental unit of the concentration space. This unit keeps track of the developing trajectory, which may appear as a flat molecular formation. The most primitive appearance of evolutionary change manifests itself in the concept of a flat structural formation. Hence, the concept will be taken as an expression of synthesis. However, as a precondition for the manifestation of growth, the unfolded spaces of the token (A2) will be presented in the Figures 1 and 2, while the corresponding spaces of the token (B2) will be demonstrated in the Figures 3 and 4.

Figure 1.

Text A2: Analytic – Descriptive Approach to the Dwarf Novel

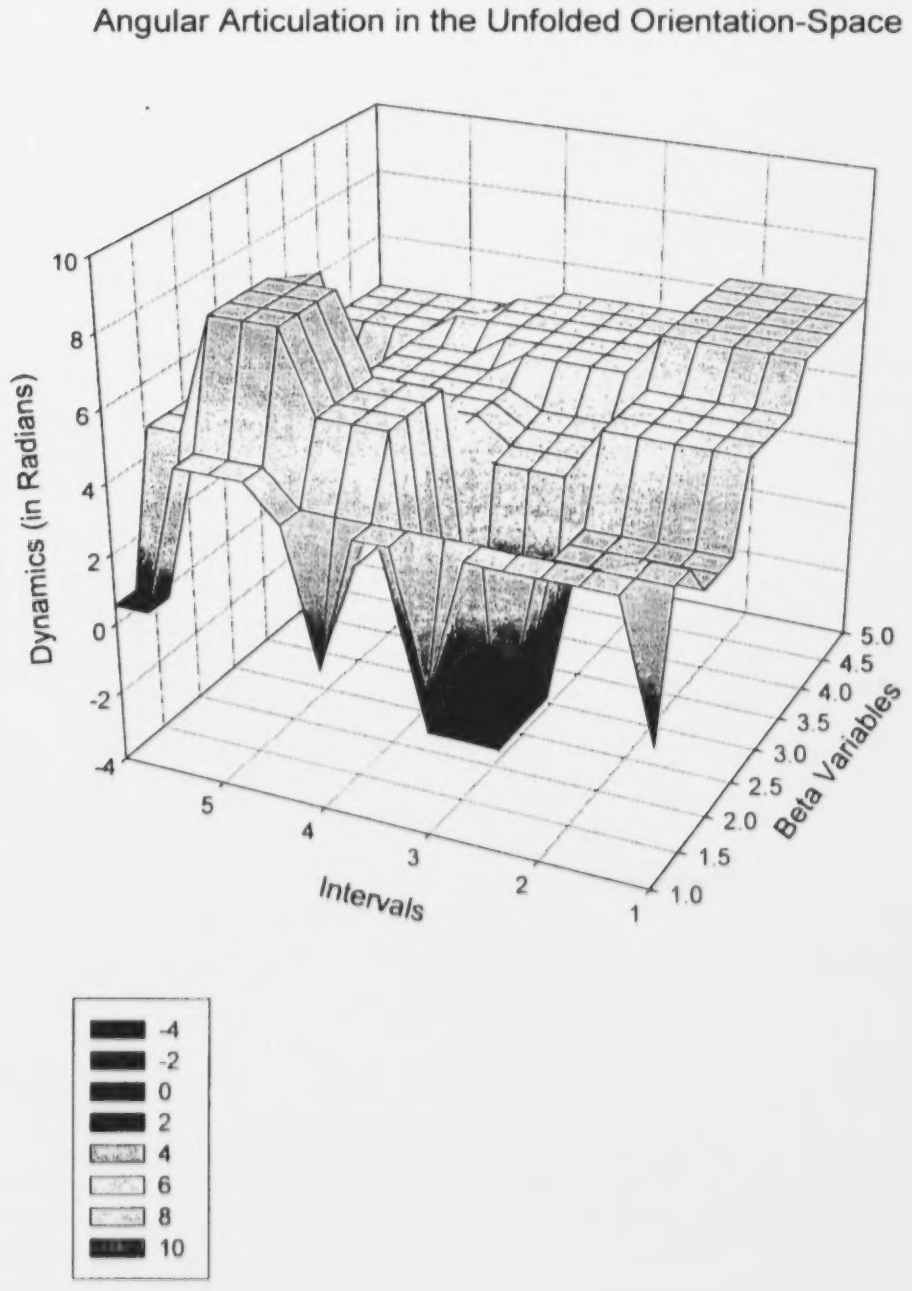


Figure 2.

Text A2: Analytic – Descriptive Approach to the Dwarf Novel

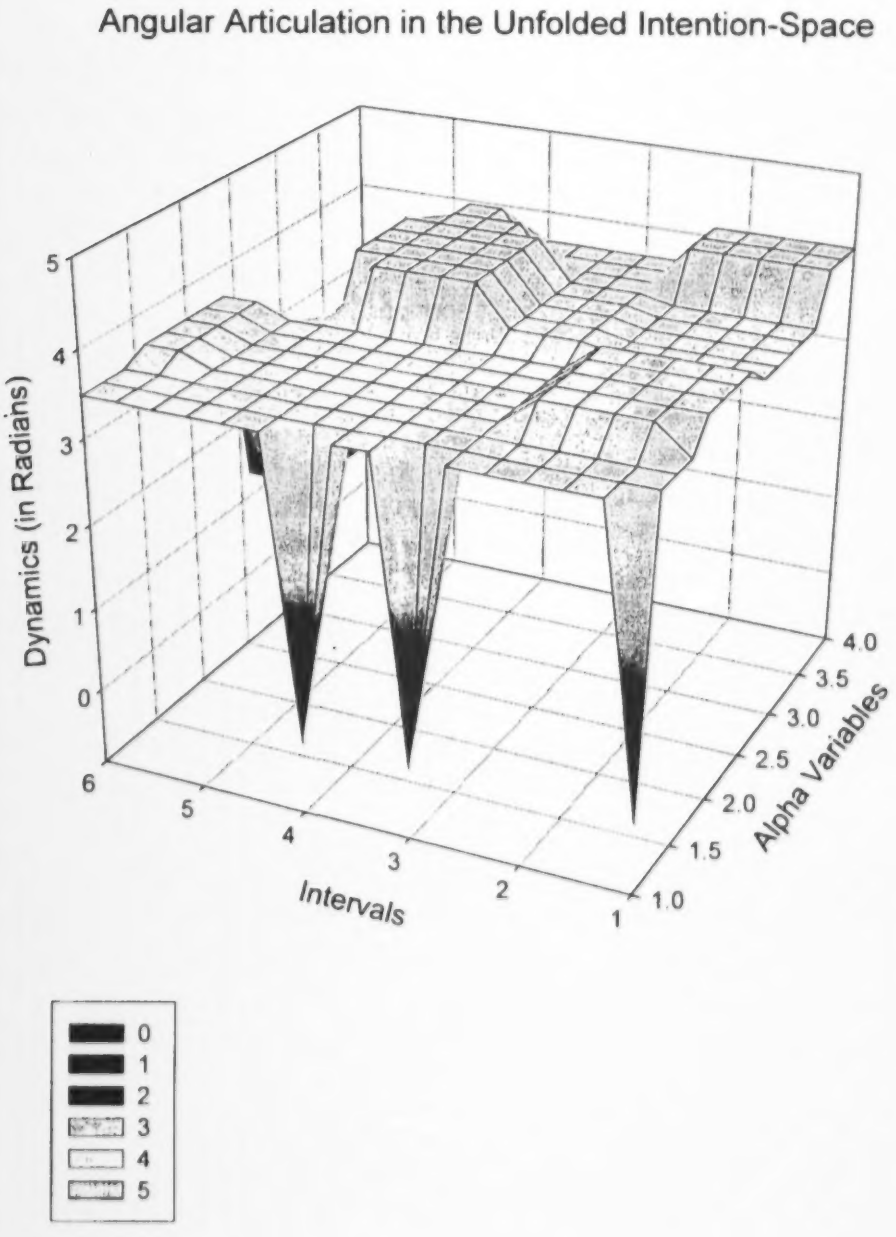


Figure 3.

Text B2: Synthetic – Reflective Approach to the Dwarf Novel

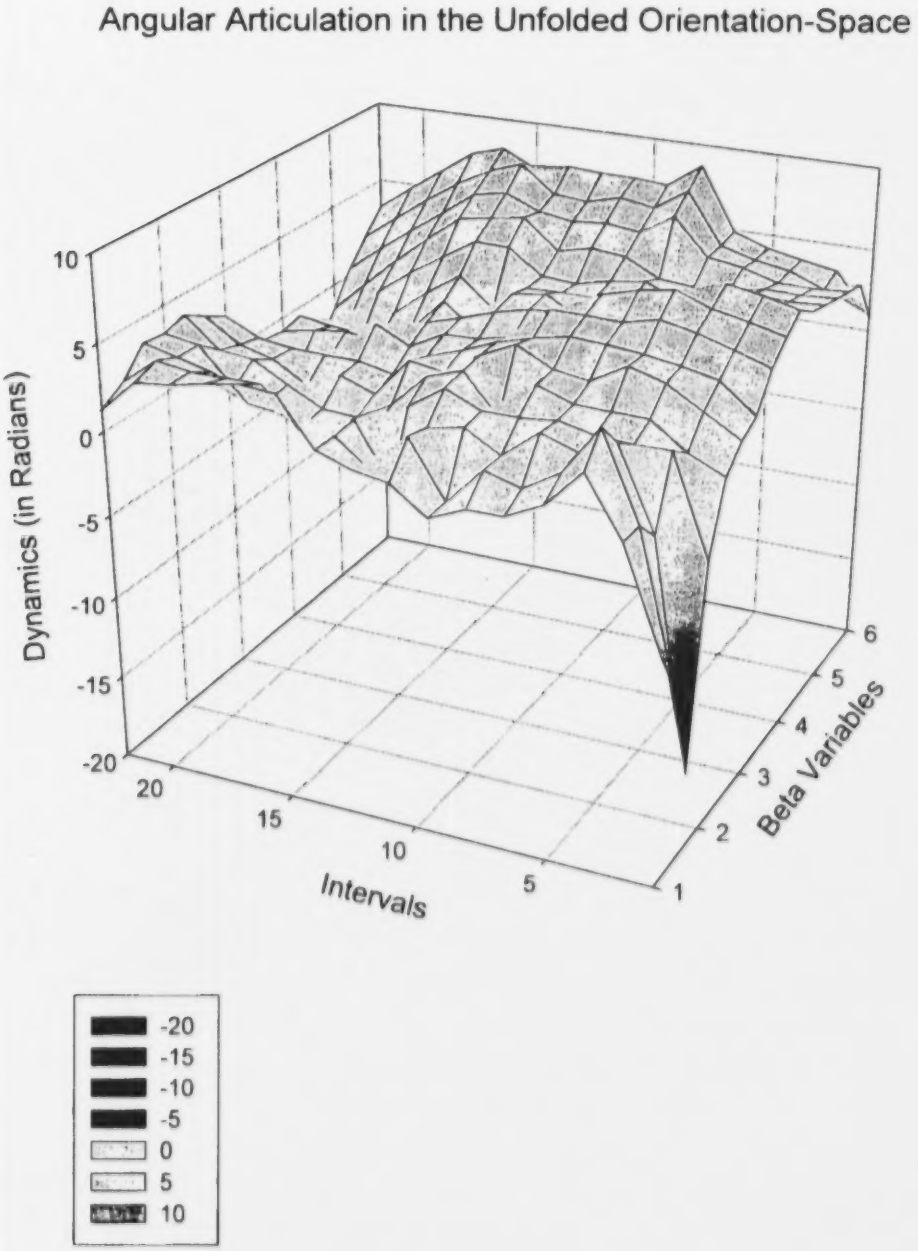
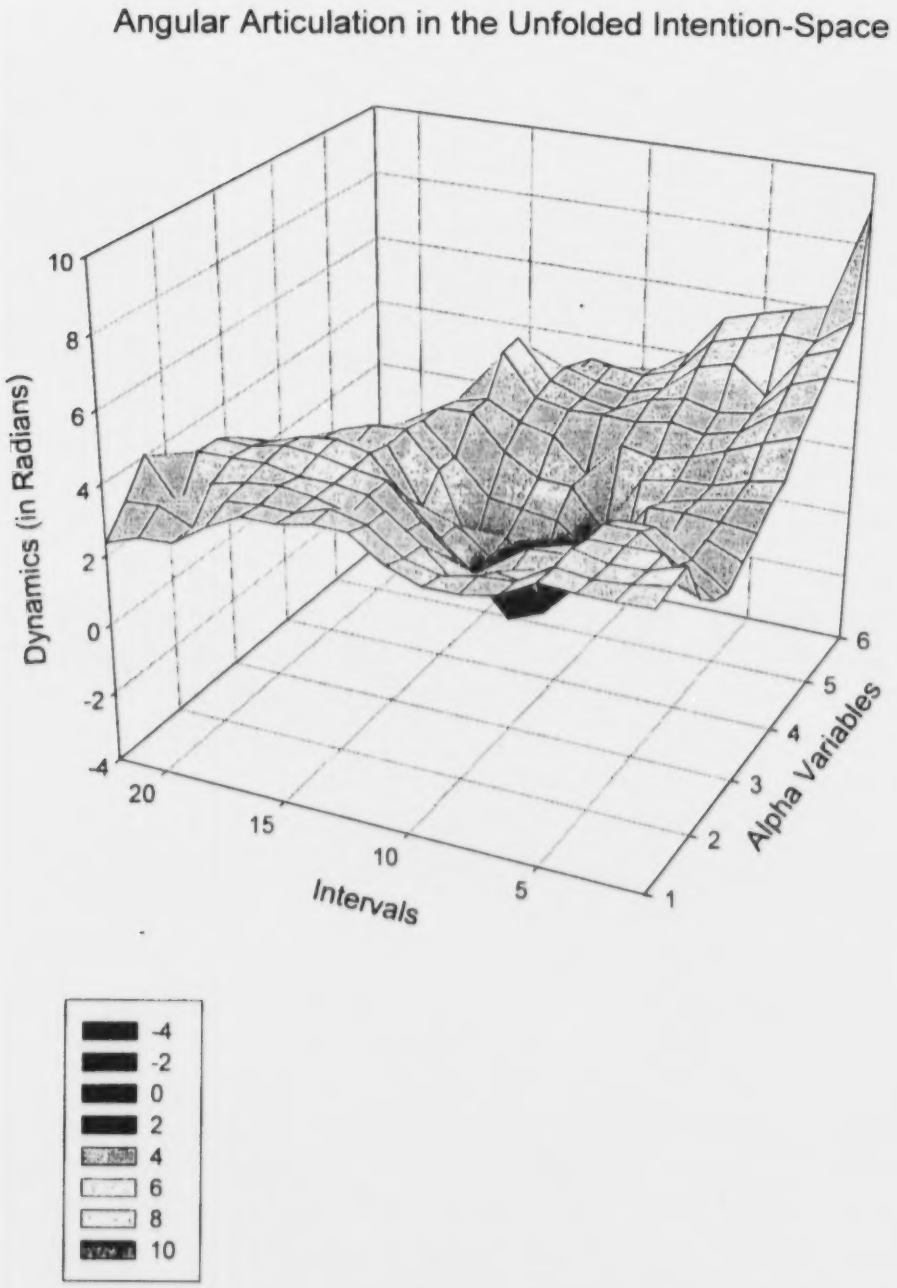


Figure 4.

Text B2: Synthetic – Reflective Approach to the Dwarf Novel



The Unfolded Spaces

One goal with studying the dynamics of text building behaviour through unfolded spaces is to see how the different rotational magnitudes of the super-strings are influencing the composition of these spaces. When examined in the context of the unfolded spaces, the magnitudes of the super-strings are connected to cyclic processes, phase-dependent transitions and accelerations. This leads to the explanation of the developing variables as a consequence of sequencing as well as supplementation processes. Hence, the production of super-strings and the unfolding of their spaces are explainable as growth processes, which are transiting various phases with varying rotational speed and thereby producing different degrees of accelerations in their curved (hyperbolic) spaces. To paraphrase Wheeler (1999, p. 235): spacetime grips the strings of the super-strings by telling them how to move, while the super-strings grip spacetime by telling it how to curve. Thus, shaped in the fashion of non-commutative geometry, individual string rotations may exhibit striking differences in angular acceleration.

As can be picked up from the Figures of the unfolded spaces, they are formed on the basis of the number of β-variables on one hand and the number of α-variables on the other. The β-variable refers to the O-component of the AaO-paradigm. This component holds the orientation, manifested through the viewpoints of the text producers. The α-variable refers to the A-component of the AaO-paradigm, which holds the intention. To reiterate the description of the shapes from the preceding study, the Y-axis of the underlying mesh represents the intervals in the way they have occurred during production. On the other hand, the X-axis represents the produced variables in relation to the intervals that have occurred. Finally the Z-axis gives expression to the dynamics as measured in radians.

Interpolation has been carried out with the smoothing method of SigmaPlot (2002, Version 8). This method is using the negative exponential, which applies the Gaussian weight function [e^{-u**2}] to weight the radians and a quadratic fit. At this stage of development, the differentiation of the textual elements is made dependent on intrinsic spacing and timing. Moreover, the time-dependent layout of the spaces is used for the purpose to process the intervals of relevance for a particular variable. The hypothesis is that a fluid form of indexing the properties of rotational dynamics provides a precise description of the places of transition, resulting from the exact reproduction of the identified control parameters.

The geometric shapes of the spaces shown in the Figures 1 and 2 appear to be quite flat. This implies that the structures in these spaces develop in trimmed fashion. Further, the course of the trajectory is progressing mainly above sea level. However some slight downward direction in the course can be observed in the Orientation-space. This change in direction can be referred to the interval, where the text producer is mentioning, that "Hitler used scientists to (Hitler) find differences...."

The geometric shape of the A-component of Figure 2 has the same trimmed form as the O-component. The A-space seems to be constructed on the basis of a fairly immobile surface pattern. Only a few places can be observed, where the trajectory curves downwards. At all occasions, this trend relates to the copying of a α-variable into a propagating cell. However, the indicated fading is not lasting long enough to bring about a deepening of the shading effect. The appearance of the deviations from pure surface orientation reflects the obvious and self-evident analytical conduct in the way of building up a text without any personal reflections. In this way, the A-component has expressed itself less varied and the result of its string dynamics has emanated in a stiffened and somewhat one-eyed contour.

A token is in the evolutionary-developmental perspective the evolutionary "unit". The understanding of the role of the variability of super-strings in the components as well as in a token must, therefore, relate to the entire text. The basic hypothesis of the present experiment

is that a subtle interplay between oscillating strings and winding strands is creating the differences in the actual spaces. It follows that this hypothesis concerns the complementary capacity of the A- and O-component to produce sub-spaces. The hypothesis of sub-space relates to the fact that the evolving sub-spaces are restricting string rotation in different ways. As a consequence, testing the hypothesis of the existence of sub-spaces will follow the mirror-strategy, proposed by Greene (1999, p. 278).

It has already been made explicit that the first step in this process must concern the splitting of the A-O-pairs. At a first glance, this split may seem to be a measure that would destroy the strict dependency in the coordinative co-operation of the A's with the O's of the AaO-system. Furthermore, producing a sub-space this way may be expected to lead to results that would be very difficult to interpret. But if the splitting operation on the A-O-pairs could lead to a step, where the space of the O-component can be separated from the space of the A-component, this step would give expression to a very radical test of the anticipated validity of the space-hypothesis of the AaO-system. Finally, if the ideas behind the stated space-"tearing" hypothesis would turn out to be a misconception, there would be "no reason in the world to expect anything but a random collection of digits" (Greene, 1999, p. 278).

In turning to the spaces of the token (B2), it becomes immediately apparent that the space of Figure 3 has been produced by means of a reflective conduct. For example, at the position of (β_6) and (β_{13}) appears the reflecting beginning: "Something I begin to think about …". In comparison with the previously discussed space, the present one is on the whole more varied and differentiated. Moreover, the higher degree of "prismatic reflections" means that the space is the result of a textual surface that has a billowing texture. The uniqueness of this orientation appears in the composition of the individual super-strings and refers to the use of modal expressions which requires that this prismatic property must simultaneously be contrasted with the "deep resonance", which relates to the virtual string of a composite, i.e., its share in the red thread of the text. For example expressions like " try to pour", "appears to try to maintain" or "should be" are not so direct and indicative compared to proposition statements. Using auxiliaries gives immediately the impression of pure reasoning, at least in a superficial perspective. Thus, pureness, variability and variety of strings and string-grapheme compounds become identical with the graphemes, characterising the surface-properties of a string.

Precisely in the same manner as the two spaces of the token (B1) are similar to each other so are the two spaces of the token (B2). The space of the A-component gives expression to a billowing softness, but without having its trajectory curving downwards. Instead, in varying the α-variables of Figure 4, the token reflects rich refractions. From the biological point of view, this measure means that novel strings are introduced and the production of a particular expression makes the dependency between individual strings and text apparent.

Thus, the pureness of individual strings constitutes the foundation of the elements of text production and the vehicle for the text producer's angular articulation of his perspective. But individual strings do not develop evolutionary. The develop into patterns of graphemes, which means that they resonate and propagate the text producer's reflections, for example when they appear as virtual strings, i.e., as placeholders. In contrast, enfolding of conceptual developments is dependent on evolutionary changes, but these changes can only appear in the folding of the super-strings. Thus, it remains to be shown what kind of conceptual development can be reflected through the folding of integrated strings and compounds. The folded spaces of the token (A2) will be presented in the form of fitness landscapes as shown in the holophors of Figure 5 and 6, while the corresponding spaces of the token (B2) will be demonstrated through the holophors of Figure 7 and 8.

Figure 5.

Text A2: Analytic – Descriptive Approach to the Dwarf Novel

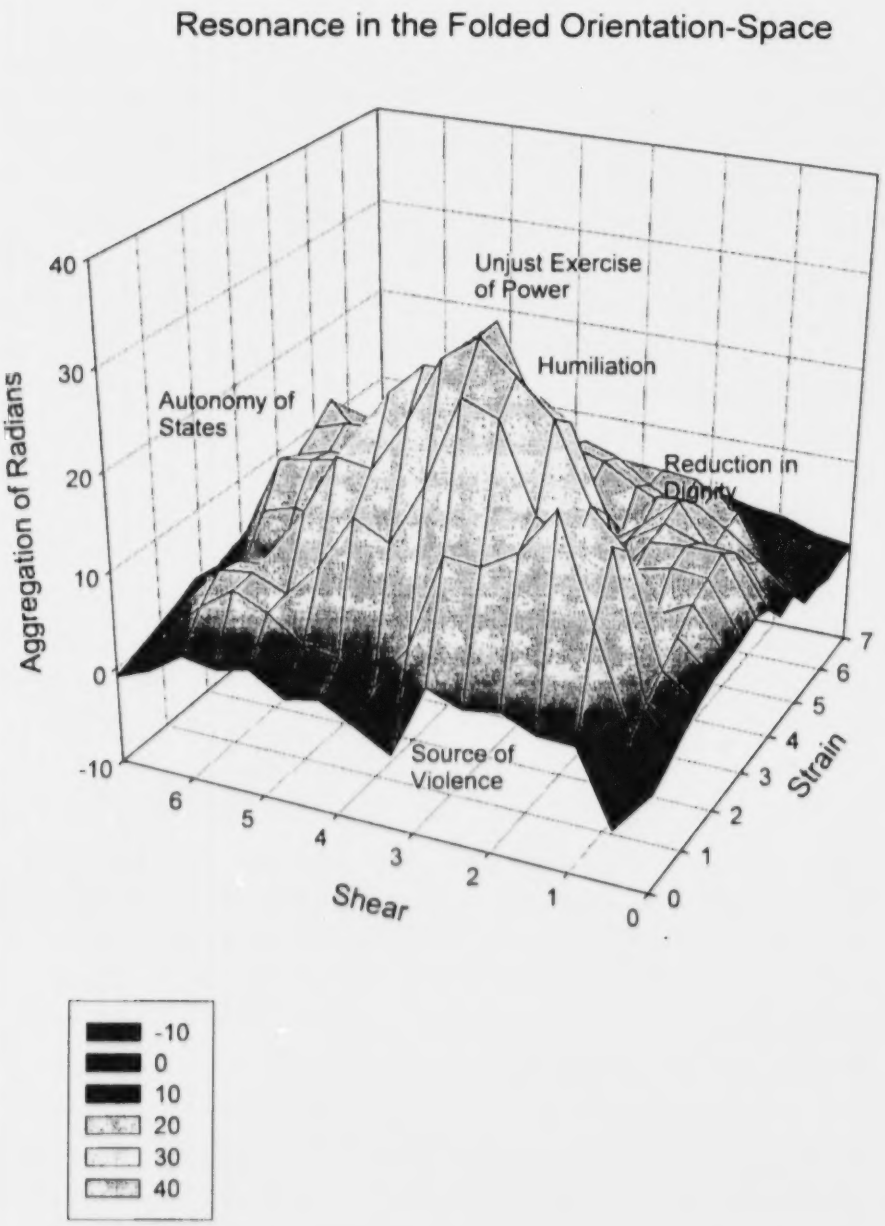


Figure 6.

Text A2: Analytic – Descriptive Approach to the Dwarf Novel

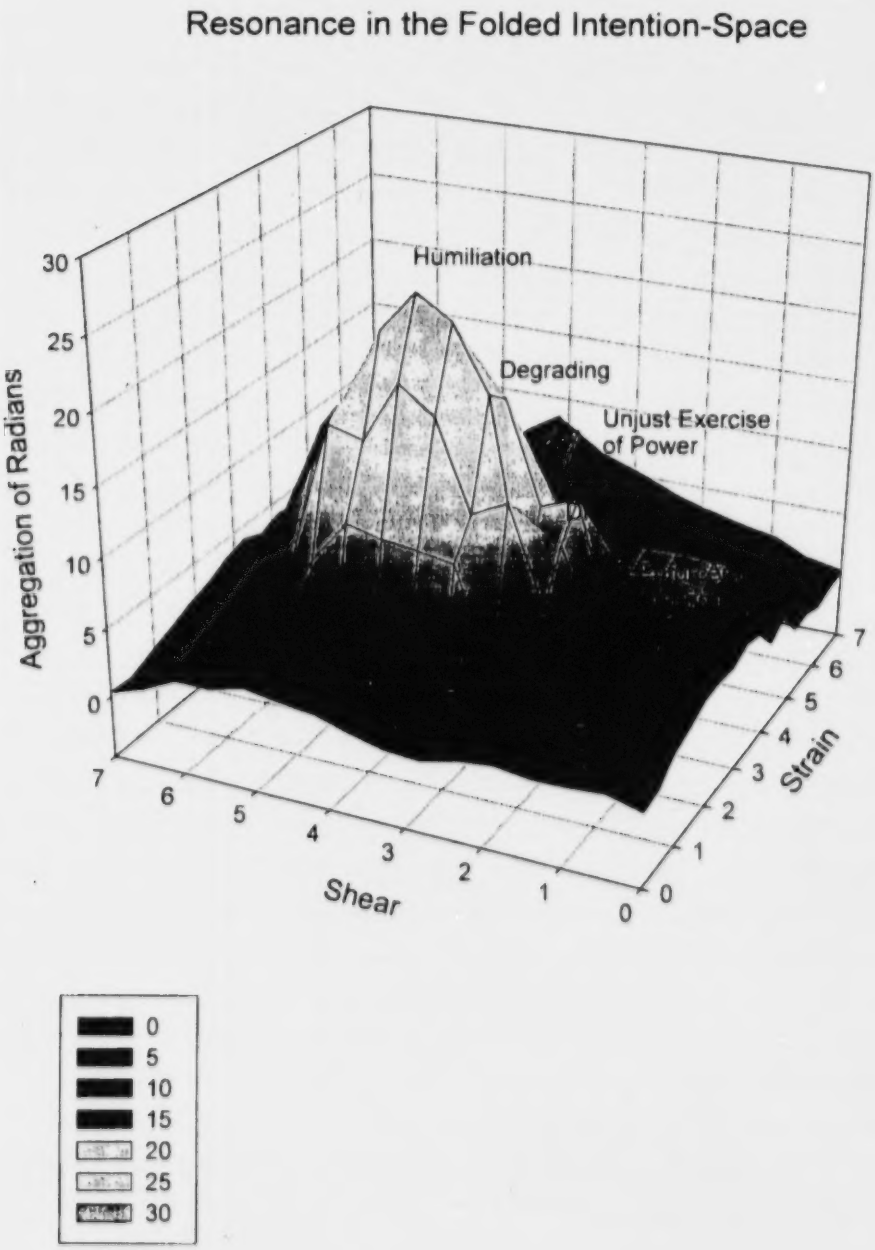


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Figure 7.

Text B2: Synthetic – Reflective Approach to the Dwarf Novel

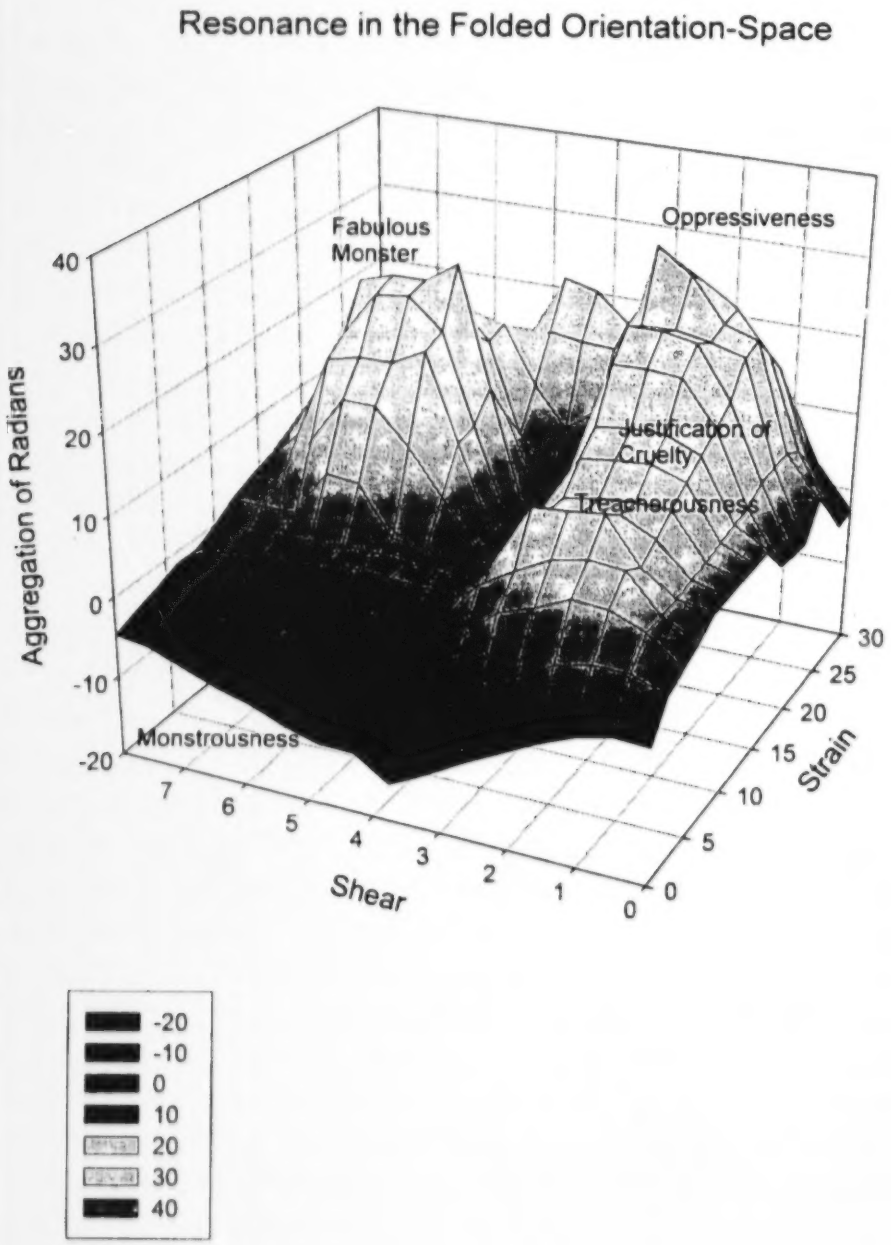

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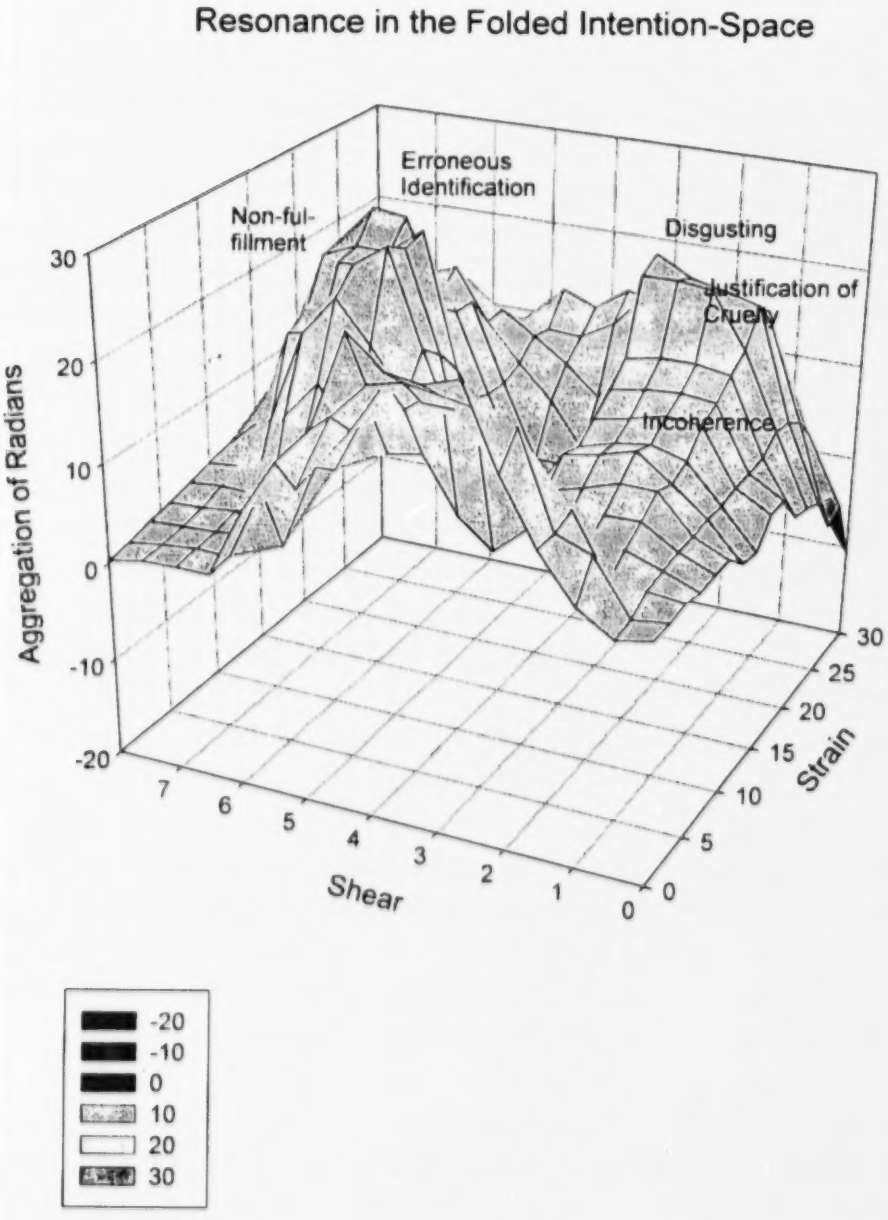
Figure 8.

Text B2: Synthetic – Reflective Approach to the Dwarf Novel



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The Folded Spaces

By applying a description in general evolutionary terms to the coupling of individual string behaviour (movement) at the kinetic level, i.e., at the micro-level with the trend in the movement at the kinematic, i.e., the macro-level, a fitness landscape can be captured and the fusion of the variables, produced in a particular interval, can be calculated and used for further processing of these fusions. When the process is jumping from one variable to another, a change in the reference variable is causing a change in the structural evolution of the landscape, which means that co-evolution is observable.

Some general observation can be made concerning the fitness landscapes of the holophors. Comparing considerations of the attractor spaces of the token (A2) makes clear that the trimming at the kinetic level reappears at the kinematic level. Again, both spaces of (A2) show fairly rudimentary folds. It follows that the folding of a flat structure must result in an unequivocally massif summit. In contrast, the spaces of (B2) show formations, which correspond with the developments at the kinetic level. The space of the O-component contains a marked field of depth. Further the differentiation of the textual surface now corresponds to several characteristic hills and peaks, which reflect concentrations of fused variable.

Compared to the holophors of (A2), it can be stated that the introduction of novel strings is generating two obvious properties. In the first place, any novel string expansion of the reference space is coupled with a growth in productivity and consequently richer diversification. Secondly, the displacement dynamics of (B2) compared to that of (A2) has generated the foundation for richer growth variations. The latter has profound influences on the number of emerging state attractors.

In the landscapes, the attractor states have been described with termini. The fewer the attractors are, the more solid or stout the landscape becomes. This implies that the functional aspect of a coordinated space has its correspondence in the termini, which are the descriptors of the attractors. Moreover, the precision in textual movement coordination makes the specificity of the termini dependent on the concrete action plan. Thus, the absence of a facetted perspective in (A2) becomes clearly expressed through the termini of the holophors. They refer in Figure 6 in some way or the other to power, an unjust exercise of power, and consequently diminished dignity and humiliation as its result.

Figure 7 demonstrates that the orientation in (B2) is barely directed towards the action plan and the exercise of power by the prince. Instead, in focus is the driving power, that is, a characterisation of wickedness itself. Obviously, something is produced, which is emerging in overwhelming untrustworthiness and cruelty. It follows that the resulting termini are establishing the fabulousness of the monster, personified by the dwarf. This demonstrates a difference concerning the critical changes, which are governing the perspectivation of something monstrous.

Figure 8 underlines this success, since the holophor manifests the disgusting properties of this cruelty but also that the dwarf cannot be measured on the basis of common human values. The text producer has thoroughly worked with an angular articulation, which has been shown to grip the "Gestalt" of the novel. The dwarf appears in the termini of the holophor of Figure 8 as incompatible, unfinished and incomplete in his actions. It follows that the termini bring out a failure in the development of the self, i.e., self-identity is missing.

Discussion

That perspective and the structure of a complete text cannot exist in latent form in the brain has been made plain in previous studies. Both must be built up during production and within the context of a continuous language space. With the introduced novelties and application of PTA, this space can be made known. Plainly, the mechanisms responsible for dynamic change, flow and rhythm are producing the complex structure of text. It is this complexity and its overwhelming capacity to reflect growth, which constitutes a formidable challenge in the establishment of structural invariants.

The present study makes a further contribution to the demonstration that this problem can be solved in dynamic geometrical terms. Since any problem in geometry can be reduced to knowledge of length or magnitude of certain straight lines, virtual or substantial, it has been possible to show that this assumption is sufficient for the reconstruction of a language space. Moreover, it is demonstrated empirically that the developed formalism has the capacity to reproduce the spaces of the text producers of the present study.

Since the presented spaces have manifested different approaches to the test materials, it can be stated that differential angular articulation can be made known and that the bookkeeping of changing attitudes can provide the basis for a manifestation of dissimilarity in perspective. In focus of the token (A2) is the action plan, where the prince and his war machinery are comprehended as a parallel to the Second World War. In contrast, the focus of the token (B2) incorporates the symbolic level of the novel. Concepts like evilness are conceived of as the driving forces behind the course of events.

Translated into different spaces, this means that the differences between the tokens concern sensibility to structural cues and how the produced spaces constrain string-movements on the kinetic level. The token (A2) is the result of a very consistent approach. Similarity in the form of the unfolded spaces implies that the contour properties between the O- and A-component are nearly symmetric in both cases. In contrast, the token (B2) has led to differences in shape. These appear as pronounced, since they now are accentuating growth differences. The folded space of the O-component is characterised by a landscape of mountains with a clear-cut perspective. This means that a valley is separating the peaks of two mountain massifs. In considering the space of the A-component, an even higher degree of softness can be observed. A ring-like growing mountain landscape is emerging with a hollow in the centre, like a doughnut. A formation of this kind is pointing towards an intricate process of structuring and growing, which has developed into an advanced synthesis.

A possible explanation for the greater degree of individual differences in the production of the token (B2), compared to the production of token (A2), may be the higher degrees of sensibility towards structural depth. The unfolded and folded spaces are demonstrating that the tokens differ in their state spaces. Moreover, the state space of the A-component of (B2) has emerged with a complementary shape in relation to the state space of the corresponding O-component. "The Dwarf" constitutes a test material, which is characterised by great variations and many ends. In the case of the token (B2), these ends have been picked up successfully and used in the synthesising process.

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